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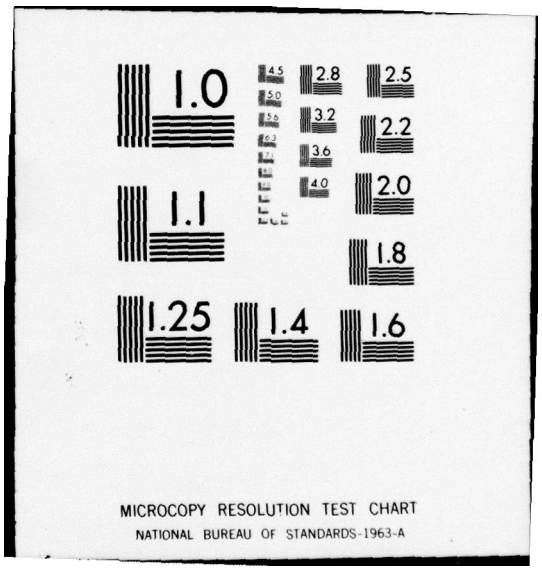
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USAAVSCOM
REPORT - TR 77-11

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IMPROVED LINEAR ACTUATOR, OH-58A HELICOPTER

C. V. Harvey
BELL HELICOPTER COMPANY
POST OFFICE BOX 482
FORT WORTH, TEXAS 76101

16 September 1974

Final Report

Prepared for

U.S. ARMY AVIATION SYSTEMS COMMAND
Maintenance Engineering Division
Post Office Box 209
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Ball Retainer, Output Shaft, Cover, Lubrication, Reliability

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This report presents the results of Product Improvement Program, Task No 72-10, wherein the engine N1 linear actuator, P/N 206-062-721-1, as installed on the OH58A helicopter, was modified for the purpose of providing better field reliability. One prototype unit was built and briefly flight tested on an OH58 helicopter.

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SUMMARY

This report presents the results of Product Improvement Program, Task No. 72-10, wherein the engine governor N_{II} linear actuator, P/N 206-062-721-1, as installed on the OH-58A helicopter, was modified for the purpose of providing better field reliability. The program in general consisted of the following:

1. Based on previous records and experience related to overhauled actuators, recommended changes to obtain better reliability in service were defined.

2. Based on the recommendations, preliminary drawings were made and submitted to AVSCOM.

3. One prototype unit reflecting these changes was built and installed on a bailed OH-58A located at BHC.

4. A brief flight test on the prototype unit was conducted and the unit thereafter was shipped to AVSCOM for disposition.

It is anticipated that Army service testing of this unit will prove that the subject modifications will provide sufficient increase in service life to warrant production incorporation. It is therefore concluded that the requirements of Contract No. DAAJ01-72-A-0015(P2E), Delivery Order No. 8, under which this program was conducted have been satisfactorily fulfilled.

DISCUSSION

This program was initiated when discussions between BHC, AVSCOM, and Globe Industries personnel were conducted for the purpose of defining the specific items that were relatively unreliable on the existing OH-58A Engine N_{II} Governor Linear Actuator, P/N 206-062-721-1. During these discussions, specific changes to provide for better reliability were formulated. It was agreed that Globe Industries, the manufacturer of the actuator, would incorporate changes as possible to a prototype unit and accordingly submit the associated drawings reflecting these changes. This was done. The specific parts that were redesigned are as follows:

1. Ball Retainer

Ball Retainer, P/N 35DG97, was replaced with ball retainer, P/N 35D716, in an attempt to eliminate failures of this part due to over-torquing of the output shaft. During field adjustment of the shaft rod end the jam nut must be loosened. The shaft has wrenching flats which are not held securely by field personnel. While loosening the jam nut, the output shaft rotates to the degree that the torquing action indents the ball retainer by compression action of the ball against the retainer groove. In many cases the ball tears through the side of the ball retainer, thus locking the output shaft and causing the actuator to fail to operate. If the ball merely indents the ball retainer, then the future operation of the actuator is impaired by the snagging effect of the ball in the damaged retainer. BHC overhaul records show that of the actuators overhauled, 100% of these retainers had to be replaced. This single item was found to be the major contributing cause of all actuator failures.

The material was changed from 430 stainless steel to type SAE 01 oil hardening tool steel. The new material can now be through-hardened to Rockwell C60-63, as opposed to case hardening by nitriding to a depth of .001-.002 inches on the original part. In addition, the thickness has been increased from .125 to .250 inches making possible use of larger steel balls. Since the new material in the heat treated condition has a tensile strength in the range of 300,000 psi along with increased cross section, the resistance to over-torquing of the output shaft is greatly increased.

2. Ball

The ball that rides in the retainer, P/N 66A161, identified in Item 1 above has been changed in size from .0937 to .1250 inches in diameter to accommodate the new larger retainer groove. Ball to groove contact point size, therefore, has been slightly increased.

3. Output Shaft

The output shaft, P/N 7A3908, has been changed in that the ball indents have been increased to accommodate the larger balls.

DISCUSSION (CONT'D)

4. Housing

A minor change in the housing, P/N 4D2692, is required in order to accommodate the thicker ball retainer. A thickness of .625 inch can be machined during overhaul from existing castings, or the die cast mold can be changed to make the part to the new dimension. This machining was accomplished on the prototype unit.

5. Cover

The change in the cover, P/N 2A997, concerns relocation of the marking information for maximum visibility after the actuator has been installed on the engine. Also, the torque caution note originally stamped on the output shaft, has been moved to the cover for improved visibility and permanence.

The stroke adjustment instructions have been reworded slightly for improved clarity, and the type size has been increased by a factor of approximately 3 for ease of reading. In addition, an important warning note has been stamped in red ink. Part number information has been relocated to the side of the actuator that is adjacent to the engine when the actuator is installed.

6. Lubrication

All gears as well as the output shaft guide assembly in the new actuator have been lubricated with a high temperature Mil Spec grease. The same is true for the cam washers in the stroke adjusting assembly. The old lube, Shell Oil Co. Aero Shell No. 7 per MIL-G-23827, meets a temperature range of -100° to $+250^{\circ}$F. The new grease is Aero Shell No. 16 per MIL-G-25760 and is suitable for operation between -65° and $+400^{\circ}$F.

This change is expected to eliminate sticking of the cam drive washers due to dried and caked grease as noted on several actuators returned from field use. In oven tests conducted as part of this investigation, the new grease remained soft and retained most of its oil after 15 hours at $+336^{\circ}$F. Under the same conditions, the old grease became dry, hard and discolored.

RECOMMENDATIONS

If service evaluation shows the modifications made as discussed in this report satisfactorily increase the service life of the actuator it is recommended that these changes be incorporated via ECP action. Further, it is recommended that in order to maintain proper control when a unit is created at the factory or modified at overhaul, a dash number change be made for identification purposes. In addition, it is believed that the red warning note placed on the actuator cover should be changed to black lettering and the word "Warning" removed.

Appendix

Enclosed in this report is an Appendix wherein the results from flight testing of the actuator are reported by the BHC Experimental Flight Test Facility. This report shows that all results were satisfactory.

APPENDIX

BELL HELICOPTER COMPANY

Inter-Office Memorandum

5 June 1974
80:BCM:wc-2753

Memo to: Mr. C. V. Harvey

Copies to: Messrs. J. Gilday, W. McKinney, R. Schwalbach

Subject: EVALUATION OF IMPROVED LINEAR ACTUATOR INSTALLED ON MODEL OH-58A HELICOPTER

Reference: (a) Organizational Maintenance Manual TM 55-1520-288-20

Introduction

In response to U.S. Army PIP Task No. 72-10, an improved linear actuator for the N_{II} governor control system on the Model OH-58A helicopter was evaluated. This improved linear actuator, P/N 206 HA-161-1, contained several internal improvements for better reliability. A redefinition and re-evaluation of the printed instructions on the improved linear actuator was made to simplify the installation and adjusting procedures.

Test and Results

The improved linear actuator was installed on Model OH-58A Helicopter, S/N 42126. The actuator was rigged in accordance with the instructions in Reference (a). A test flight was made and a normal adjustment of the actuator rod length was made to compensate for this particular engine and actuator installation.

A total flight time of 0.3 hr. was flown on 27 May 1974, during which all phases of the normal flight regime were investigated. There were no abnormal characteristics of the 206 HA-161-1 linear actuator noted or any differences from normal helicopter operation with the standard 206-062-721-1 linear actuator.

Conclusions

From this investigation it was concluded that the installation, rigging and operation of the improved linear actuator was satisfactory.

B. C. Martin
Flight Test Engineer
Ext. 4822

Approved by:

W. E. Jennings
Chief Flight Test Engineer

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